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Trowbridge - Plan for a Bridge across East River - 1868.

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PROPOSED PLAN

FOR

BUILDING A BRIDGE

ACROSS THE

EAST RIVER,

AT

BLACKWELL'S ISLAND.

BY

W. P. TROWBRIDGE, A. M.,
Vice-President of the Novelty Iron Works.
(Late Corps of Engineers, U. S. A.)

WITH PLANS.

NEW YORK:
D. VAN NOSTRAND, No. 192 BROADWAY.
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There is probably no topic of greater interest to the city of New York, at present, than that which relates to additional or increased facilities of communication with the surrounding country.

A large portion of the business population of the city are obliged, from considerations of economy, or domestic comfort and convenience, to seek places of residence beyond the limits of Manhattan Island, either in New Jersey, West Chester County, or on Long Island; and the number of these non-resident business men and workmen, who come to the city and return to their homes daily, has become so great, that the inadequate capacity of the ferry communications, and their irregularities in winter, have become matters of general complaint.

There is one direction in which relief may be obtained which has not received that attention which it deserves, not only on account of its practicability, but also from the large extent of territory, now unimproved and sparsely settled, which may be brought within a few minutes' transit of the heart of the city.

This mode of relief is the building of a bridge suitable for carrying rail-cars, carriages, and loaded teams, as well as foot passengers, across the East River at Blackwell's Island; and the object of this paper is to describe a plan which I believe to be new, but entirely practicable, for constructing this great thoroughfare in a manner which shall secure convenience, safety, and permanence, beyond all doubts and apprehensions. And also to present such considerations connected with the commercial and financial value of the project as the circumstances seem to warrant.

In an undertaking of such magnitude, involving large amounts of money to be expended in a single structure, those who embark in it will demand that it shall be clearly shown that the project is not only practicable, as far as questions of engineering are involved, but also that their investments shall return a fair interest, and be permanently secured through the marketable value of the property acquired.

These latter considerations will be discussed subsequent to the description of the proposed

BRIDGE AND VIADUCT.

The East River, at Blackwell's Island, is divided by the island into two channels ; the east channel, in its narrowest part, being about six hundred and fifty feet wide, from high-water mark to high-water mark, the corresponding width of the west channel being about seven hundred and eighty feet, and the width of the island seven hundred and thirty-five feet.

On the New York side of the river the ground rises abruptly to the height of about sixty feet ; and on the Long Island side, to the height of twenty feet, falling off inland to a salt marsh, and rising again to sixty feet elevation at a distance of about four thousand feet from the river.

The engineering difficulties of the problem lie principally in the spanning of the water channels, the spans being very large, except for a suspension bridge ; and the great altitude required for the passage of shipping, combined with the length of span, rendering the erection of auxiliary centres, or staging, for the construction of single girders or arches, quite impracticable.

To render the system which I propose practicable, the spans are reduced to five hundred feet each, by building the channel piers somewhat in the water ; thus leaving all of the deep water of the channels available for navigation, while the distance from pier to pier admits, as I hope to show, of a safe and practicable construction for a permanent bridge, quite different from a suspension bridge.

Before explaining the mode of constructing these difficult spans it is proper to enunciate the essential conditions to be fulfilled.

The principal requisites of a great structure of this character are:

First. That it shall be SAFE: and it is not sufficient that it shall be *theoretically* safe for all loads that may be brought upon it, but its security must be so perfectly demonstrated by practical experimental tests as to remove all apprehension on the part of the public, as well as to assure those who provide the means for the execution of the work, of the safety and permanence of their investments. This condition is controlling and all-important; for where it is proposed to provide a transit for thousands of people daily, with trucks, carriages, wagons, loaded teams, and railway cars, at an altitude of one hundred and thirty feet, across a single span of five hundred feet, the strength, durability, and permanence of the structure must be beyond all suspicion.

Second. The next essential condition is that the execution of the work shall be practicable with a reasonable outlay, and without risk of failure.

Third. The structure must be suitable and convenient, as far as the above-named circumstances will allow, for the uses for which it is designed.

The plan which I propose is a combination of counterbalanced half girders with the single girder, in a manner which I have not seen suggested heretofore, but which appears to fulfil all the conditions above enumerated in a satisfactory manner; while its execution may be accomplished by the most simple mechanical operations.

Referring to the accompanying drawings, I propose to commence operations for each channel by building the piers (as shown in the sketch marked A) up to the level of the ground, on each side of the channel. After a firm foundation shall have been prepared at this level, counterbalanced half-girders are constructed, of wrought-iron, of such dimensions that when pushed out, the portions which overhang the channel shall meet; these overhanging portions being counterbalanced by auxiliary weights. The mode of construction represented in the drawing is to build iron towers forming a part of the movable half-girders, from the top of which suspension rods, or suitable suspension systems of rods, or chains, descend to the ends of the half-girders.

When one half-girder is completed, it is to be tested practically by raising it from its foundation by means of hydraulic power, and building up supports under one-half its length (as shown in sketch B). Counterweights are then placed upon one end, and heavy loads upon the other, until the capacity of the overhanging portion to sustain the heaviest loads is fully tested. This operation may be accomplished without risk, and at a small cost. The half-girder having been tested, it is ready to be pushed, or launched out over the channel. But it must also be raised to its final altitude. The latter operation is performed by means of hydraulic power, the piers being built up underneath the girder as it rises. When the final altitude is reached, the half-girders on each side are pushed out until they meet over the middle of the channel. A half-girder in this position is represented in figure C.

It is evident that in this position one-half of the span is self-sustaining, and is capable of bearing all the load that was put upon it in the practical test. When the opposite half-girder is pushed out to meet it, the channel is effectually spanned (sketch D), and the strength of the system definitely determined.

It is proposed, however, to build each of the half-girders of such a form and dimensions that if the two are firmly united at the point of junction, they will together form a continuous single girder across the channel, capable in itself of sustaining a load greatly in excess of any that will ever be brought upon it; leaving out of consideration the additional strength and security gained by the counterbalanced method by which it was constructed. The junction of the half spans is therefore made in such a manner that the structure may be regarded as a continuous single girder, or as a combination of two self-sustaining and independent half-girders; and the strength and security of the system are thus practically doubled.

More than this may also be claimed; for the structure, regarded as a single girder, has one element of advantage over ordinary single girders, in having both ends fixed and extended over the piers on each side, these ends being heavily loaded or fastened, so that before the girders can give way, ruptures must take place at the middle of the span and also at the piers, and the strength is thus increased theoretically about one-third. The combination appears, therefore, to contain all the elements of security that can possibly be united under the circumstances; elements which are not to be attained by any other system; with the additional important advantage, that one of these elements of the combination has been thoroughly tested to sustain a greater load than the three combined will ever be called upon to bear. A degree of stiffness, and freedom from vibration, much greater than is to be found in other systems, is also secured.

It may be remarked that after the half-girders are pushed out, the auxiliary weights used for counterbalancing may be removed, and the inland ends may be secured by strong tie-rods to the piers, thus substituting the heavy masonry of the piers for the auxiliary counterweights (as shown in sketch D).

An altitude of one hundred and thirty feet is considered necessary for the passage of shipping, and the towers will be raised to the height which may be found necessary for the most favorable support of the overhanging lengths of the half-girders.

It is not intended in this description to indicate the details of the construction, nor indeed to present any particular form of girder, but merely to illustrate the general principles of the system.

On the Long Island side of the river the roadway is built upon piers and arches, with a suitable grade for railway cars, to the level of the ground in the rear of Ravenswood; and on the New York side, a similar construction is extended to some distance from the river, where it is terminated, at an altitude of about sixty feet, in a station house.

While railway cars may start from an elevated station above the streets on the New York side, and must descend by a practicable grade on the Long Island side, the approaches for carriages, wagons, cattle, etc., must begin and end at the level of the ground.

These approaches may, however, have a steeper grade than the railway track, and as the bulk of the travel across the bridge will be by private conveyances, the common roadway should on this account occupy the lowest position.

It is designed, therefore, that these approaches shall be built beneath the arches, and between the piers, on each side, thus avoiding a double system of piers and arches (as shown in the general drawing). The common roadway will begin at a point near Third avenue on the New York side, and will end at a distance of about twenty-five hundred feet from the river on the Long Island side. The construction of this roadway under the arches and from pier to pier is shown at E, E, E.

Exact estimates of cost cannot be made until all the details shall have been determined; but more favorable conditions in regard to economy cannot well exist in any structure across the two channels, which shall meet the necessities of the case. It is not anticipated that this bridge will cost more than a suspension bridge, while its superiority in strength and safety might warrant an amount of expenditure if it were necessary, much greater. A half million, or a million dollars more, provided it secure safety and permanence, will bring its own return in the increased value of the property.

The mode of construction described by building the half-girders at the level of the ground, and afterwards raising them gradually by hydraulic power, and building the piers under them, will be a source of great economy, and is suggested principally with this view. All the operations of building the most difficult parts of the structure will be conducted at the level of the ground, where men can work with ease and confidence; while in other systems all of this difficult work must be done at a great altitude, and under embarrassing circumstances for the workmen.

COMMERCIAL VIEW OF THE ENTERPRISE.

It now remains to point out briefly the financial and commercial considerations of the question. Although this is not the province of the engineer, yet in the case under consideration, the engineering problems are important, only in connection with the public improvements which must follow the successful execution of the proposed work.

The proposed location of the bridge is upon a line drawn from about the middle of the Central Park to Fl~~ushing,~~ Newtown, Long Island. On this line, after crossing the East River, there is a district of country containing about sixteen square miles, the centre of which lies only three and a half miles from the river, and four miles from the Central Park.

The principal part of this district is still under farm cultivation, notwithstanding its proximity to the great metropolis ; and the whole is very sparsely settled, except in the vicinity of the villages of Hunter's Point, Astoria, and Newtown.

The average value of this ten thousand acres is probably not more than one thousand dollars an acre ; making a total valuation of ten millions of dollars.

With a communication such as has been described, it is safe to estimate that the immediate enhanced value of the same land would be five thousand dollars an acre, making a total increased value, as the immediate effect of the building of the bridge, of fifty millions ;

and within a few years this region, which is now unoccupied and unimproved, would probably become densely populated.

It is generally high, with a gravelly soil, and is in every way admirably adapted for residences ; and a glance at a general map of New York city and its environs will show that this is the only district, so near the heart of the city, that has not already been laid out into streets, and divided in building lots, 25 × 100. The river here offers the most tempting conveniences for a bridge, in presenting, as it does, Blackwell's Island as the natural foundation of the great central piers, and dividing itself into two comparatively narrow channels ; thus affording facilities not found at any other point for the erection of a structure so urgently demanded by public interests.

There can be no more appropriate time than the present for inaugurating this great enterprise. Capital is abundant ; there are no great public works in progress which might interfere with the execution of this, and the certainty of immediate returns from the money invested admits of no doubt.

That such an undertaking will, at no distant day, be accomplished, and a great city built upon the site which has been described, there is little doubt ; but the time when that shall be realized will depend greatly upon the building of continuous communications across the East River.

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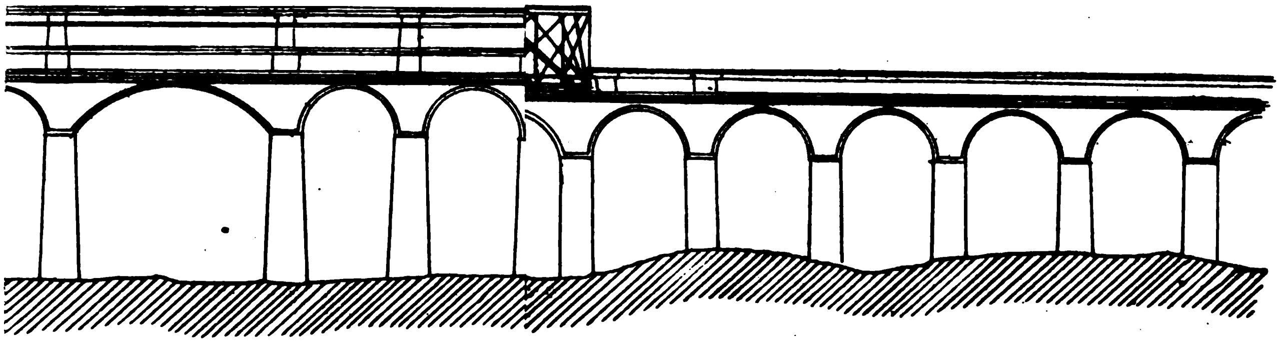
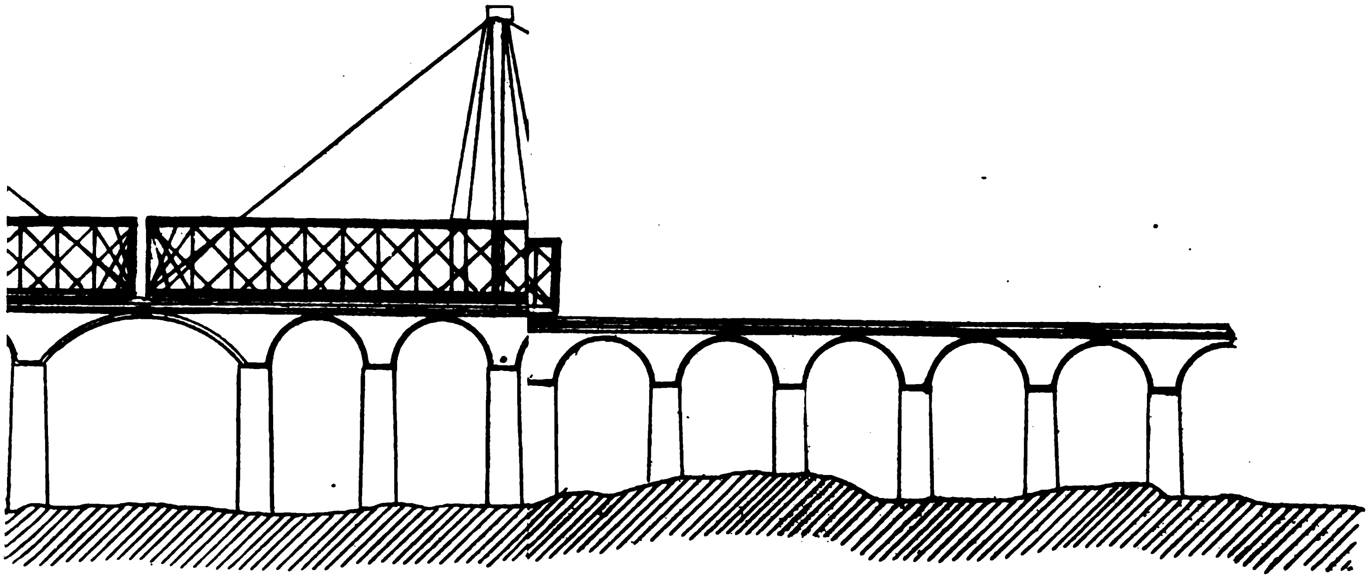
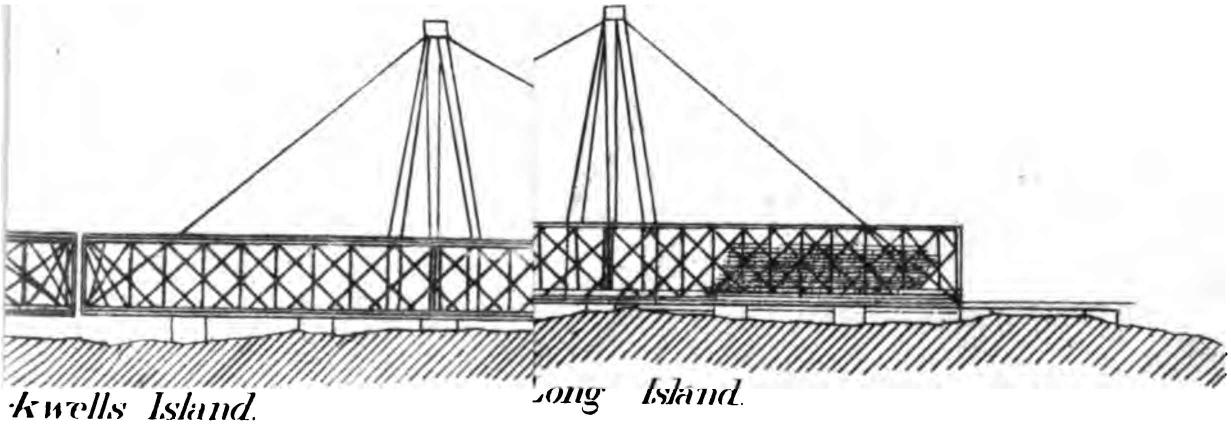
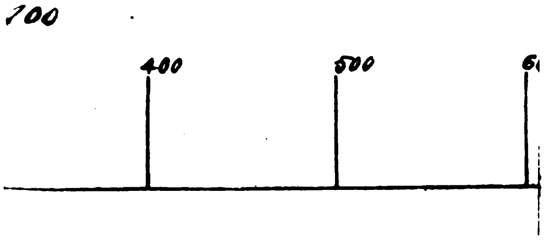
across East River









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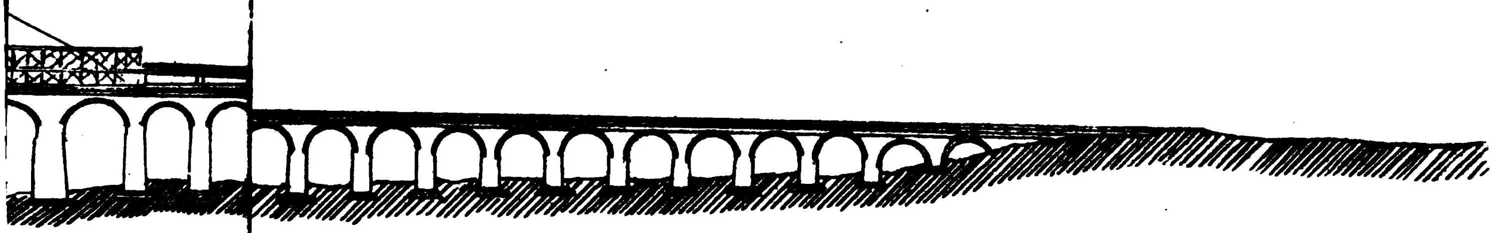

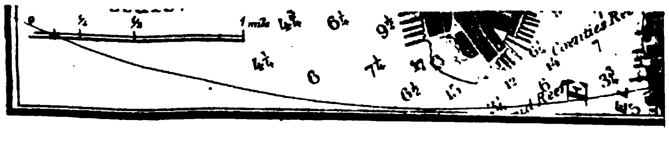

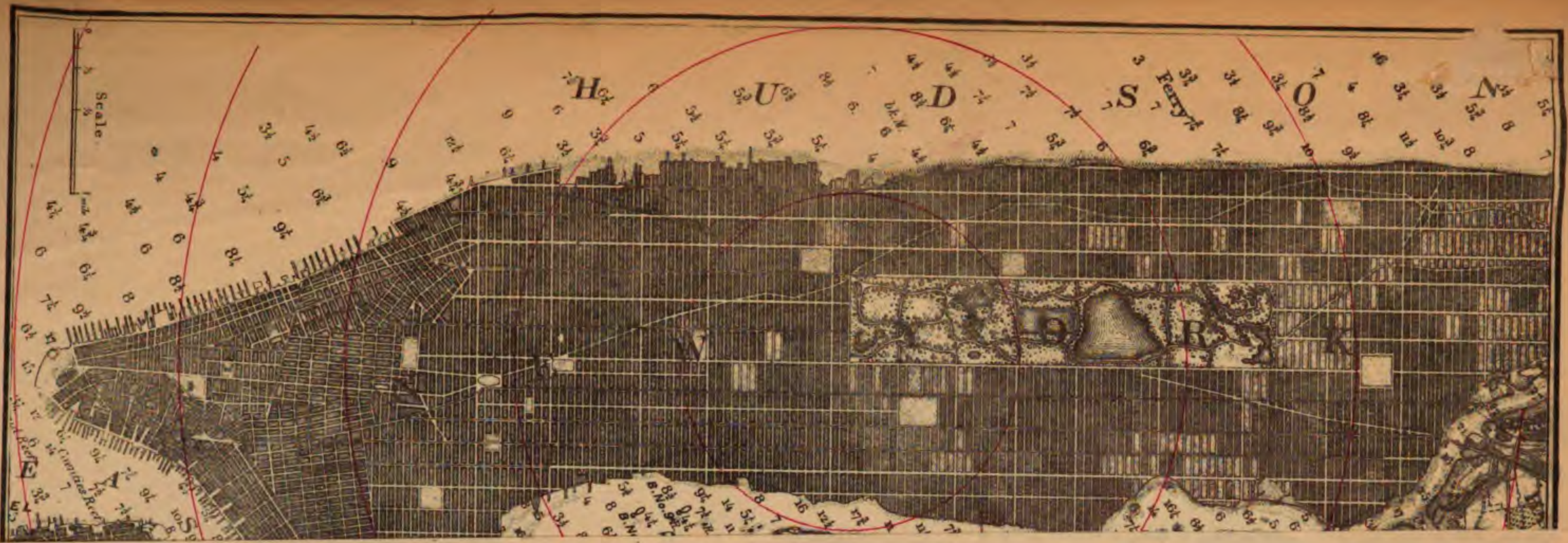

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